

2014-1041
(Interference No. 105,898)

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

ROBERT ROZBICKI, MICHAL DANEK, AND ERICH KLAUHN,

Appellants

v.

TONY CHIANG, GONGDA YAO, PEIJUN DING, FUSEN E. CHEN,
BARRY L. CHIN, GENE Y. KOHARA, ZHENG XU, AND HONG ZHANG,

Appellees.

Appeal from the United States Patent and Trademark Office,
Patent Trial and Appeal Board

BRIEF OF APPELLEES

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February 12, 2014

CERTIFICATE OF INTEREST

Counsel for Appellee Chiang certifies the following:

1. The full names of every party represented by me are:

The party Chiang et al., constituting Tony Chiang, Gongda Yao, Peijun Ding, Fusen E. Chen, Barry L. Chin, Gene Y. Kohara, Zheng Xu and Hong Zhang

2. The names of the real parties in interest represented by me are:

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3. All parent corporations and any publicly held companies that own 10% or more of the stock of the parties represented by me are:

There are no parent corporations or publicly held companies that own 10% or more stock of Applied Materials, Inc.

(Applied Materials, Inc. and Tokyo Electron Limited have announced an agreement to create a new company via merger.)

4. The names of all law firms and the partners or associates that appeared for the party now represented by me in the trial court or agency or are expected to appear in this court are:

Kenyon & Kenyon LLP: John R. Kenny, Maria Luisa Palmese, Joseph A. Coppola, Gaudenis Vidugiris and Christopher M. Scott (no longer with Kenyon & Kenyon)

February 12, 2014

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STATEMENT OF RELATED CASES

There are no appeals in or from the same civil action or proceeding in the lower court or body that were previously before this or any other appellate court.

There are no cases known to counsel to be pending in this or any other court that will directly affect or be directly affected by this court's decision in the pending appeal.

I. STATEMENT OF THE ISSUES

1. Whether the Board correctly construed the term “etching” in claims 31-90 of U.S. Serial No. 11/733,671 by Chiang et al. (“Chiang,” “671 application,” “Chiang claims”).
2. Whether substantial evidence supports the Board’s finding that even if Rozbicki’s proposed construction for “etching” were adopted, Rozbicki failed to prove a lack of written description for the Chiang claims on appeal.
3. Whether substantial evidence supports the Board’s finding that Chiang is entitled to the benefit of U.S. Serial Nos. 10/922,052; 10/796,602; 09/886,439; and 08/978,792 (“Chiang priority applications”).

II. STATEMENT OF THE CASE

The appeal is from an interference declared between Chiang claims 31-90 and claims 1-73 of U.S. Patent No. 6,607,977 to Rozbicki et al. (“977 patent,” “Rozbicki,” “Rozbicki claims”). (A56.)¹ The Count is the alternative of Chiang claim 31 or its identical counterpart, Rozbicki claim 1. (A56.) When the interference was declared, the Board accorded Chiang the benefit of its priority applications for the Count. (A57.)

In the interference, Rozbicki moved to challenge written description support for the Chiang claims and the Count. Rozbicki’s main challenge was directed to

¹ Citations to “A__” refer to the Joint Appendix. Citations to “Br. at __” refer to Rozbicki’s opening brief.

the term “etching,” which is recited directly or indirectly by each Chiang claim and by the Count. Rozbicki argued that “etching” should be construed as limited to “net etching” and that the ’671 application and Chiang priority applications purportedly fail to disclose net etching. After considering detailed expert testimony, the Board ruled against Rozbicki on both issues. (A15.) The Board refused to limit “etching” to net etching, and found that, regardless, Chiang discloses net etching in the ’671 application and its priority applications. (A15.) While the Board ruled against Rozbicki regarding “etching,” the Board carefully considered Rozbicki’s challenges to Chiang’s support for certain dependent claims and found in Rozbicki’s favor for Chiang claims 40-45, 48, 52, 54, 56, 58, 62, 65, 72-75, 86 and 89 for unrelated reasons. (A20.) Neither party is appealing the Board’s rulings on the dependent limitations. Therefore, the Chiang claims on appeal are 31-39, 46, 47, 49-51, 53, 55, 57, 59-61, 63, 64, 66-71, 76-85, 87, and 88.

Priority was not an issue in the interference. Chiang’s first priority application was filed years before Rozbicki’s alleged date of invention. (A57; A348.) The Chiang specification published more than a year before Rozbicki’s alleged date of invention. (A348; A2666.) Accordingly, the Board awarded judgment on priority to Chiang, cancelling the Rozbicki claims. (A44.)

On appeal, Rozbicki focuses on the issue of written description support in the '671 application for the etching limitation recited in Chiang claim 31. Rozbicki, however, only challenges Chiang's support for etching when Rozbicki's rejected construction is applied. Rozbicki does not challenge Chiang's support for etching as construed by the Board.

Rozbicki repeats the claim construction and factual arguments that it made below, but provides no legitimate basis for disturbing the Board's carefully considered claim construction or findings of fact. Instead, Rozbicki seeks improperly to read the limitations of "net etching" from the '977 patent into claims that recite only "etching." Rozbicki asks this Court to ignore the evidence supporting the Board's findings, ignore the Board's evaluation of that evidence, and substitute its own factual analysis of what the '671 application conveys to one skilled in the art. Rozbicki asks this Court to credit the testimony of its expert, whom the Board found less credible, over the testimony of Chiang's expert, whom the Board found more credible.

For the reasons stated below Rozbicki fails to establish an erroneous claim construction or a lack of substantial evidence for support for net etching—both of which it must establish to prevail. The Board's judgment should be affirmed.

III. STATEMENT OF FACTS

A. The Chiang Claims Are Directed to a Method for Depositing a Barrier Material That Can Be Used to Manufacture Integrated Circuits

The Chiang claims are directed to a method for depositing barrier materials on wafer substrates. Semiconductor manufacturers use wafer substrates to make integrated circuits, such as those employed in computers. (A2625.) The wafer substrates contain semiconductor devices that are electrically connected to form the integrated circuits. (A2626-27.) The electrical connections are formed using vias, openings in a layer of silicon dioxide above the wafer substrate. (A1180-81; A2635.) Vias are filled with metal to make electrical connections. (A1180-81; A2635.)

Traditionally, semiconductor manufacturers used aluminum to fill the vias. (A1180; A2626.) But, as manufacturers continued to reduce the size of their interconnections, they started using copper, which has lower resistivity than aluminum. (A1180; A2626.) Copper, however, has the drawback that it can diffuse into adjacent silicon dioxide. (A1181, A1200, A2627.) As the '671 application teaches, this problem can be solved by placing a layer of barrier material between the silicon dioxide and the copper to prevent that diffusion. (A1190; A2640.) The Chiang claims are directed to a method of depositing barrier material.

B. The Claimed Method Deposits Barrier Material in Two Steps; the Second Step Etches the Bottom of a Via While Depositing Elsewhere

The method of Chiang claim 31 uses two steps to deposit barrier material on a wafer substrate: first, barrier material is deposited and, second, the bottom of the via is etched while barrier material is deposited elsewhere. (A179.)

Chiang claim 31 reads:

31. A method for depositing a diffusion barrier and a metal conductive layer for metal interconnects on a wafer substrate, the method comprising:
 - (a) depositing a first portion of the diffusion barrier over the surface of the wafer substrate;
 - (b) etching the first portion of the diffusion barrier at the bottom of a plurality of vias without fully etching through such that an amount of barrier material remains at the bottom of the plurality of vias, while depositing a second portion of the diffusion barrier elsewhere on the wafer substrate; and
 - (c) depositing the metal conductive layer over the surface of the wafer substrate such that the metal conductive layer contacts the barrier material remaining at the bottom of the plurality of vias;

wherein at least part of (a) and all of (b) are performed in the same processing chamber.

(A179.)

C. Etching Means the Removal of Material

The parties agree that the term “etching” in Chiang claim 31 should be construed in light of the ’977 patent, the original source of the claim’s language.

The parties also agree that etching requires the removal of material. The dispute between the parties is whether etching should be further limited to net etching—the net removal of material leading to a net decrease in the thickness of a layer. Rozbicki argues it should: “Etching in this regard refers to a net etching, i.e., a net reduction in the thickness of the first portion of the diffusion barrier.” (A243.) But the Board found that limiting etching to net etching would improperly import limitations from the ’977 patent’s specification into the claims. (A5, A15; A35.) The Board therefore adopted Chiang’s construction that “etching” means the removal of material. (A15.) The ’977 patent supports that construction.

The ’977 patent teaches that etching and deposition can occur simultaneously at the same location (e.g., the bottom of the via). (A1169; A2653 ¶ 99.) To describe the net effect of etching and deposition, the ’977 patent uses the terms net etching and net deposition. Net etching means that etching exceeds deposition, and net deposition means that deposition exceeds etching. (A1174; A2653 ¶ 98.) An analogy is a bank transaction with a withdrawal and a deposit. When a customer withdraws \$100 in cash while depositing a \$50 check, the customer makes a net withdrawal of \$50. When the customer withdraws the \$100 in cash while depositing a \$200 check, the customer makes a net deposit of \$100.

To define whether etching exceeds deposition, the ’977 patent provides a simple calculation: divide the amount or rate of etching by the amount or rate of

deposition and compare that ratio to one. (A1173-74; A2653 ¶ 99.) If the ratio is greater than 1, etching exceeds deposition and there is net etching: “[t]he etch to deposition ratio (E/D) ratio can be controlled so that it is > 1 in the via bottom and [sic] (resulting in net etching).” (A1174 col. 13 ll. 11-13; A2653 ¶ 99). If the ratio is less than one, there is net deposition: “The magnitude of E/D on the side walls is < 1 ... The sidewalls receive a net deposition.” (A1174 col. 13 ll. 13-19; A2653 ¶ 99.) These definitions establish that etching is broader than net etching, in contrast to Rozbicki’s proposed construction that equates the terms. Etching may exceed deposition and result in net etching, but it does not have to result in net etching. Etching can be less than deposition and thus result in net deposition. Revisiting the banking analogy, if a customer withdraws \$100 in cash while depositing a \$50 check, the withdrawal to deposit ratio is 2—a net withdrawal. If the same customer withdraws \$100 while depositing a \$200 check, the withdrawal to deposit ratio is 1/2—a net deposit. In both scenarios, the customer has made a \$100 withdrawal even though the latter resulted in a net deposit.

Rozbicki’s proposed construction for etching renders the terms “net etching” and “net deposition” illogical. (A2653 ¶ 100.) Under Rozbicki’s proposed construction, etching means net removal of material (A2021 at 41:2-4), and deposition is the net growth of material. (A2020 at 37:9-11; A2653 ¶ 98.) Net etching means the net net removal of material, and net deposition means the net net

growth of material, neither of which makes sense. Even Rozbicki's expert, Dr. Ruzic, was unable to provide any logical meaning for "net etching" when etching is given Rozbicki's proposed construction. (A6; A2019 at 33:4-34:11.) That construction also renders the E/D ratio nonsensical. (A2653 ¶ 100.) With it, the ratio would be the net removal of material divided by the net growth of material. But, because net removal and net growth cannot both occur, their ratio cannot be calculated. (A2653 ¶ 100.)

In contrast, the Board's construction gives meaning to the terms "net etching" and "net deposition" and the disclosed E/D ratio. Etching is the removal of material, and deposition, the opposite of etching, is the growth of material. (A2653 ¶ 98.) Net etching is the net removal of material, and net deposition is the net growth of material. (A2653 ¶ 98.) The E/D ratio is the ratio of the amount or rate of removal to the amount or rate of growth. That ratio can be compared to 1 to determine whether net etching or net deposition is occurring.

D. Etching Has a Thinning Effect Even When It Does Not Result in the Net Removal of Material

Rozbicki argues that the term etching should be construed to require thinning of a layer. (Br. at 24.) Whether Rozbicki means the net thinning of a layer (like net etching) or simply a thinning effect is unclear. The former would improperly read a limitation from the specification into "etching." The latter does

not require Rozbicki's construction. The Board's construction of etching—the removal of material—has a thinning effect.

Even Dr. Ruzic's flawed analysis demonstrates that etching as construed by the Board has a thinning effect. Dr. Ruzic used scientifically unsound assumptions that caused him to underestimate the amount of etching occurring in that step. (A2651 ¶¶ 94-95.) Nevertheless, according to his analysis, the second step of Example 3 of the '671 application deposits barrier material at the rate of 5 Å/s and removes barrier material at 3 Å/s. (A1660-61 ¶ 18; A2652-53 ¶ 97.) As he testified, those rates yield net deposition at a rate of 2 Å/s ("Dr. Ruzic's 5/3/2 Analysis"). (A1660-61 ¶ 18; A2652-53 ¶ 97.) Under this analysis, no net removal of material occurs, and there is no net reduction in the thickness of the barrier layer. Nevertheless, even with this analysis, the 3 Å/s removal, "etching" as construed by the Board, had a significant thinning effect. Without that removal, Dr. Ruzic testified that the final barrier layer would have been 300 Å thick at the bottom of the via. (A1660-61 ¶ 18; A2652 ¶ 96.) The removal in the second step alone reduced the final thickness by a factor of two, to 150 Å. (A1660-61 ¶¶ 16-18; A2652 ¶ 96.) To use the banking analogy, a \$100 cash withdrawal has a reductive effect on an account balance when accompanied by either a \$50 or a \$200 check deposit. In both cases, the effect of a \$100 withdrawal is a \$100 reduction in the value of the account.

E. It is Uncontested That the '671 Application Describes Etching as the Board Construed That Term

Rozbicki has not challenged Dr. Cuomo's testimony that the '671 application describes etching as the Board construed the term. (A2641 ¶ 67; A2645 ¶ 75.) Dr. Ruzic's flawed 5/3/2 analysis, which underestimates etching, nevertheless establishes etching with the Board's construction. (A1660-61 ¶ 18; A2652-53 ¶¶ 96-97.) Moreover, the next section addresses net etching, which by definition requires etching, and also provides support for the limitation.

F. The '671 Application Discloses Net Etching at the Bottom of a Via

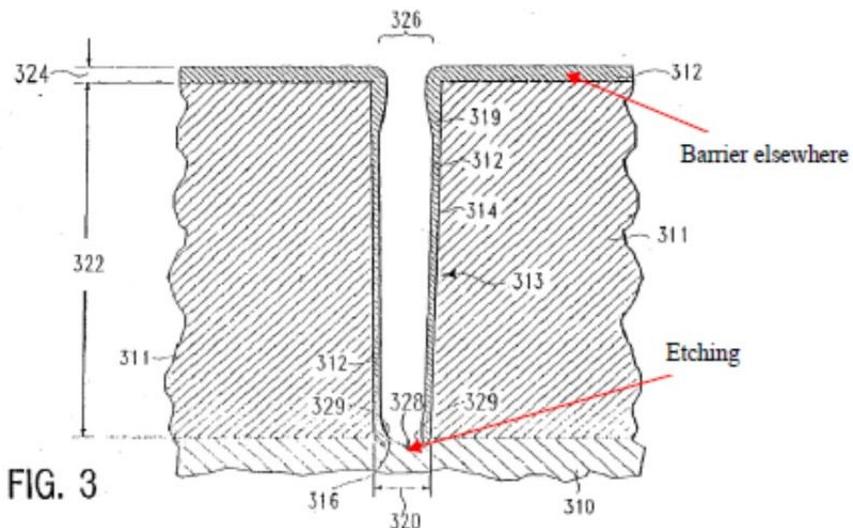
As the Board found, the '671 application describes net etching at the bottom of a via. (A15.) It does so by describing techniques, examples and terms that convey net etching to one skilled in the art. The '671 application describes two deposition techniques. One technique deposits barrier material while adding an electrical bias to the wafer substrate. (A2630-33 ¶¶ 42-47.) The other technique deposits barrier material without a substrate bias (or with only a substantially low substrate bias). (A2633-34 ¶¶ 49-50.) The '671 application teaches that both have drawbacks when used in isolation. (A2633-34 ¶¶ 48, 50.)

The '671 application teaches combining the techniques to overcome their drawbacks. (A2635 ¶ 53.) The application teaches first depositing barrier material without a substrate bias to avoid inducing net etching, and then applying a sufficiently high substrate bias to net etch the bottom of the via while depositing

barrier material elsewhere. (A2635 ¶ 53.) This combination of techniques is the invention of Chiang claim 31 even as etching is construed by Rozbicki. (A2630-31 ¶ 42, A2635 ¶ 53.) The '671 application includes a working example of each technique in isolation and the claimed combination in Examples 1-3. (A2630-31 ¶ 42, A2633-36 ¶¶ 49-53.)

1. Example 1: Net Etches the Bottom of the Via, but Yields a Poor Barrier Layer

In Example 1, barrier material is deposited using a “high substrate bias” that net etches the bottom of the via while depositing barrier material elsewhere. (A1198 ll. 15-19; A2632 ¶ 45, A2640 ¶ 62.) The barrier layer produced by Example 1 is shown by the schematic of its scanning electron microscope profile in Figure 3:



(Annotations added.)

(A1198 ll. 5-9, A1210; A2631-32 ¶ 44.)

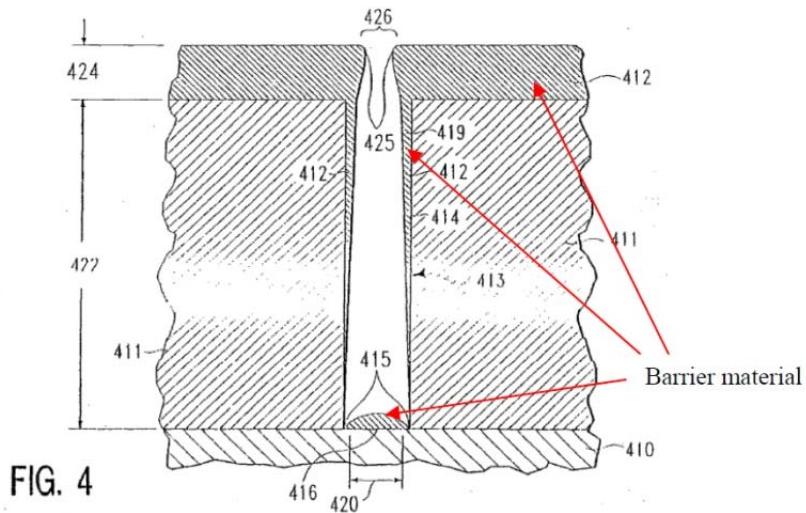
As shown, the high substrate bias net etches the bottom of via 313 while depositing barrier material elsewhere, as step (b) of Chiang claim 31 requires. (A2632 ¶ 45.) Dr. Cuomo testified that breakthrough 328 conveys net etching (i.e., net removal) at the bottom of via 313 to one skilled in the art. (A2632 ¶ 45, A2640 ¶ 62.) Even Rozbicki's expert, Dr. Ruzic, who construed etching as net etching, admits that Figure 3 shows "etching." (A2031 at 83:4-12.) As shown, the deposition with the high substrate bias deposits barrier material (tantalum 312) elsewhere: above silicon dioxide layer 311 and on the sidewalls of via 313. (A1198; A2631-A2632.)

The only difference between step (b) of claim 31 and Example 1 is that the latter does not deposit barrier material before net etching the bottom of the via. As a result, in Example 1, the substrate, rather than previously deposited barrier material, is net etched.

The '671 application teaches that this net etching of the substrate is problematic because it contaminates the barrier layer with the substrate and forms build up 329 in the corners of via 313. (A1187 ll. 20-25; A1198 ll. 9-12, 17-22.) This "typically leads to leakage and poor resistivity within the contact structure," so that "device function [c]ould be very adversely affected, if not destroyed." (A1198 ll. 22-25.)

2. Example 2: Does Not Etch the Bottom of a Via, but Produces a Poor Barrier Layer

Example 2 deposits barrier material without a substrate bias. The barrier layer it produces is shown by the schematic of its scanning electron microscope profile in Figure 4:



(Annotations added.)

(A1199 ll. 1-6, A1210; A2633-34 ¶ 49).

As shown, the absence of a substrate bias results in the deposition of barrier material (tantalum) 412 at the bottom of via 413, on via 413's sidewalls, and on top of the silicon dioxide layer 411, satisfying the requirements of step (a) of Chiang claim 31. (A1199 ll. 10-15; A2634 ¶ 50.)

The '671 application teaches that the barrier layer produced by Example 2 is poor: the thickness of barrier layer 412 is “minimal (if present at all) at the corner[s] 415 near the bottom 416 of via 413.” (A1199 ll. 15-16.) This thinness

allows subsequently applied copper fill to diffuse “into both the silicon dioxide layer 411 and into the silicon substrate 410.” (A1199 ll. 17-20; A2634 ¶ 50.) And, this diffusion of copper “eventually lead[s] to device failure.” (A1200 ll. 5-6.)

3. Example 3 Combines the Steps of Examples 1 and 2, Net Etches the Bottom of the Via, and Produces a Useful Barrier Layer

Example 3 overcomes the drawbacks of Examples 1 and 2 by combining their steps: first, it deposits barrier material with no substrate bias to avoid net etching the bottom of the via; then it adds what the Summary of the Invention terms a “sufficiently high substrate bias” to net etch the bottom of the via while depositing barrier material elsewhere. (A1188 ll. 6-13; A2635 ¶ 53.) Barrier layer 512 produced by Example 3 is shown by the schematic of its scanning electron microscope profile in Figure 5:

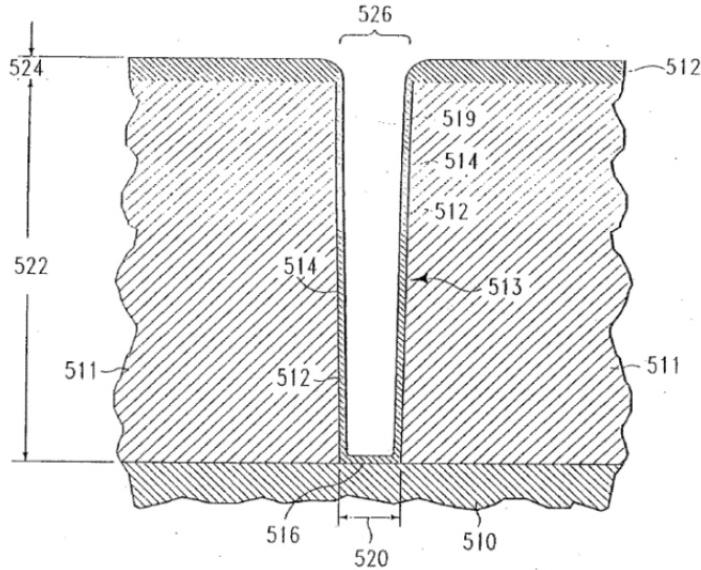


FIG. 5

(A1200 ll. 16-20, A1211; A2635-36 ¶ 53.)

Barrier layer 512 lacks the drawbacks of Examples 1 and 2. (A1190 ll. 10-13, A1201 ll. 6-10; A2639-40 ¶¶ 60-62.) The sufficiently high substrate bias does not break into substrate 510 like Example 1. (A1190 ll. 10-13; A2640 ¶ 62.) Barrier material neither builds up nor is thin near the corners of via 513, like Example 2. (A1201 ll. 6-10; A2639 ¶ 60).

The '671 application explains why this claimed combination of steps overcomes the drawbacks of performing the same steps in isolation. The first step of Example 3 deposits barrier material in the same way as Example 2, but for a shorter duration. (A2636-A2637 ¶ 55.) The second step uses the sufficiently high substrate bias that produces net etching at the bottom of the via, but does not break

into the substrate because it net etches barrier material (tantalum) deposited in the first step, rather than the underlying substrate: “Availability of the material that was deposited at the lower bias voltage … avoids breakthrough into the substrate which could destroy device functionality.” (A1190 ll. 5-13; A2640 ¶ 62.) This teaching would not make sense if the second step did not result in net etching. (A38; A2640 ¶ 62.) Absent net etching, the potential for breakthrough would not exist and the previously deposited barrier material would be protecting the substrate from nothing. (A2640 ¶ 62.)

The '671 application uses the terms “resputtering” and “reshaping” to describe the net etching of the second step of Example 3. The term resputtering, rather than sputtering, is used because that step sputters previously deposited barrier material. As Rozbicki notes, resputtering means the sputtering of previously deposited material. (Br. at 44.) The application states that in the second step of Example 3: “tantalum from the first deposition period was resputtered, with excess tantalum being removed from the area of opening 526 of via 513 and reshaped in the area near the bottom 516 of via 513.” (A1201 ll. 3-5). As Dr. Cuomo testified, in this context, the terms resputtering and reshaping convey net etching. (A2639 ¶ 60.)

A comparison of Figures 3, 4 and 5 demonstrate that the sufficiently high substrate bias in the second step of Example 3 net etches the bottom of via 513. As

Dr. Cuomo testified, Figure 4 shows the effect of the first step of Example 3: barrier material that is thick in the middle of the via but thin in the corners (a convex shape, like a hill). (A1210; A2639 ¶ 61.) Figure 3 shows the effect of the second step: net etching at the center of the via with added material to the corners (a concave shape, like a valley). (A1210; A2639 ¶ 61.) The effect of combining those steps is the flat barrier layer shown in Figure 5. (A1211; A2639 ¶ 61.) In other words, as the Board found, the net etching of the second step offsets the excess deposition in the center of the via produced by the first step. A11. And, as the Board found, “[i]t is not clear how Chiang’s disclosure would make any sense if etching [with both parties’ proposed constructions] is not occurring in the second step [of Example 3].” A38. The Summary of the Invention further confirms this. It teaches that the second step sculpts a shape from previously deposited material. (A1188 ll. 11-13.) As Dr. Cuomo testified, sculpturing conveys net etching to one skilled in the art. (A2639 ¶ 60.)

4. Dr. Cuomo's Sputtering Yield Analysis Confirms Net Etching at the Bottom of the Via

As Dr. Cuomo testified, the sputtering yields, plasma potential and ion flux for the second step of Example 3 establish net etching the bottom of the via. (A2646-A2651.) As he stated, whether ions in deposition equipment etch material depends on their energy. (A2646 ¶ 80.) Ions obtain energy from a plasma potential. (A2646 ¶ 80.) To produce more energetic ions, a semiconductor

manufacturer can add a substrate bias, which provides additional energy to the ions. (A2646 ¶ 80.) Sputtering yields measure the number of atoms sputtered (removed) by each striking ion. (A2647 ¶ 81.) For example, a sputtering yield of 0.1 means that one atom would be removed from the surface for every ten ions that strike it. (A2648 ¶ 85.)

Dr. Cuomo relied on peer-reviewed literature, which discloses pertinent plasma potentials of -25 to -50 eV. (A2647-48 ¶ 84.) These plasma potentials (plus the 60 eV provided by the substrate bias) provide 85 to 110 eV of energy to the ions in Example 3. (A2648 ¶ 84.)

Dr. Cuomo (and Rozbicki's expert Dr. Ruzic) modeled Example 3 using argon as the gas and tantalum as the metal. (A1663 ¶ 23; A2648 ¶ 85.) Seminal articles by Stuart et al. and Laegrid et al. report sputtering yields for argon ions striking tantalum. (A2775, A2777 tbl. 1; A2780, A2786 fig. 11; A2648 ¶ 85.) The lowest reported sputtering yield, for the lowest boundary of the ion's energy range, is 0.063. (A2649; A2786 fig. 11.) Dr. Cuomo pointed out that, Tanaka et al., which uses the equipment described in the '671 application, establishes that the flux ratio of argon to tantalum is at least 19. (A1902 fig. 7; A2649-50 ¶¶ 89-90.) That means that 19 argon ions strike the bottom of the via for every tantalum ion that does. With a sputtering yield of 0.063, those 19 argon atoms remove 1.2

atoms. (A2651 ¶ 93.) Removing 1.2 tantalum atoms for every deposited tantalum ion results in an E/D ratio of 1.2, meaning net etching is occurring. (A2651 ¶ 93.)

This ratio is a floor. As Dr. Cuomo testified, at an energy value close to the middle of the ion energy range, 100 eV, the sputtering yield reported by the literature is 0.1, meaning that the E/D ratio would be at least 1.9. (A2775, A2777 tbl. 1; A2780, A2786 fig. 11; A2648 ¶ 85.) The ratio could be even higher if one accounts for the additional etching by tantalum, the non-normal incidence of striking ions, and the fact that ion flux in Example 3 would be expected to be higher than in Tanaka. (A2649 ¶ 88, A2651 ¶ 93.) Tanaka included nitrogen in its plasma and applied a higher power to its target than Example 3 does. (A1902 fig. 7; A2650 ¶¶ 90-91.) The absence of nitrogen ions in both experts' model of Example 3 and the lower target power of that example will produce a higher ion flux ratio than Tanaka. (A2650 ¶¶ 90-91.)

IV. STANDARD OF REVIEW

The proper interpretation of claims is a question of law reviewed de novo on appeal. *Cybor Corp. v. FAS Techs., Inc.*, 138 F.3d 1448, 1454-55 (Fed. Cir. 1998) (en banc).² Whether the '671 Application and the Chiang priority applications describe the Chiang claims when properly construed is an issue of fact, and the

² This principle is currently under en banc review by this Court in *Lighting Ballast Control LLC v. Philips Elecs. North Am. Corp.*, Fed. Cir., No. 2012-1014 (oral argument held September 13, 2013).

Board's findings of fact are reviewed for substantial evidence. *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000). Substantial evidence "is something less than the weight of the evidence but more than a mere scintilla of evidence." *In re Kotzab*, 217 F.3d 1365, 1369 (Fed. Cir. 2000). Substantial evidence is "such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *Consol. Edison Co. v. NLRB*, 305 U.S. 197, 229 (1938). If "the evidence in [the] record will support several reasonable but contradictory conclusions," then this Court "will not find the Board's decision unsupported by substantial evidence simply because the Board chose one conclusion over another plausible alternative." *In re Jolley*, 308 F.3d 1317, 1320 (Fed. Cir. 2002). This Court "defer[s] to the Board's findings concerning the credibility of expert witnesses." *Yorkey v. Diab*, 601 F.3d 1279, 1284 (Fed. Cir. 2010).

V. SUMMARY OF ARGUMENT

1. The Board correctly construed the term "etching." The Board's construction—the removal of material—is the broadest reasonable interpretation for etching in light of the specification of the '977 patent. With the Board's construction, the terms net etching and net deposition and the E/D ratio in the '977 patent make sense. Those same terms and ratio are rendered illogical by Rozbicki's proposed construction, which improperly imports the limitations of net etching into the term etching.

2. Support for the Chiang claims with the Board's construction is undisputed.

3. Substantial evidence supports the Board's finding that, even with Rozbicki's proposed construction for etching, the '671 application provides sufficient written description to support the Chiang claims. The application describes resputtering that causes breakthrough in the substrate (when the substrate is not protected) and sculptures and reshapes barrier material. That is net etching. The text and figures of the '671 application describe net etching, explain why net etching is problematic when used alone, and explain why it is beneficial when used in the claimed method. The '671 application discloses a working example of the claimed invention that net etches barrier material, a fact confirmed by Dr. Cuomo's sputtering yield analysis. As the Board found, the '671 application would not make sense if etching, using either construction, were not occurring.

4. The same substantial evidence supports the Board's finding that the Chiang priority applications disclose etching. The '671 application and the Chiang priority applications are continuations of one another, having essentially identical specifications.

VI. ARGUMENT

A. The Board Correctly Construed the Term “Etching”

The Chiang claims were essentially copied from the ’977 patent and are therefore construed in light of that patent. *See Koninklijke Philips Elecs. N.V. v. Cardiac Sci. Operating Co.*, 590 F.3d 1326, 1335 (Fed. Cir. 2010). Claims are given their broadest reasonable interpretation before the Board. *In re Zletz*, 893 F.2d 319, 321-22 (Fed. Cir. 1989). Limitations from a patent specification, however, may not be read into those claims. *Id.* The Board’s construction for etching is the removal of material. (A15.) That construction, which was proposed by Chiang, is the broadest reasonable construction of “etching” in light of the ’977 patent.

As discussed in the Statement of Facts, Rozbicki agrees that etching requires the removal of material, but seeks to further limit that term to net etching. Rozbicki’s proposed construction is the net removal of material, resulting in the net decrease in the thickness of a layer. (Br. at 31.) In Rozbicki’s words: “Etching in this regard refers to a net etching, i.e., a net reduction in the thickness of the first portion of the diffusion barrier.” (A243 ll. 13-14.) Construing etching to be net etching renders the terms net etching and net deposition in the ’977 patent illogical, and conflicts with the patent’s teachings that etching can occur without net etching.

(A2653 ¶¶ 99-100.) The Board's construction is reasonable, creates none of these conflicts, and therefore should be affirmed.

1. Only the Board's Construction Is Reasonable in Light of the '977 Patent

The Board's construction is consistent with the teachings of etching and net etching in the '977 patent. According to the Board's construction, etching is the removal of material, and with this construction the terms "net etching" and "net deposition" in the '977 patent make sense. Since deposition, the opposite of etching, is the growth of material, net etching is the net removal of material, and net deposition is the net growth of material. (A2653 ¶ 98.) The E/D ratio also makes sense: the E/D ratio is the ratio of the amount or rate of removal to the amount or rate of growth, and that ratio can be used to determine whether net etching or net deposition is occurring. (A2653 ¶ 99.)

Rozbicki's proposed construction disregards the '977 patent's teachings of net etching, net deposition, and E/D ratios. The patent teaches that etching yields net etching only when the E/D ratio is greater than 1: "[t]he etch to deposition ratio (E/D) ratio can be controlled so that it is > 1 in the via bottom and [sic] (resulting in net etching)." (A1174 col. 13 ll. 11-12; A2653 ¶ 99.) The patent also teaches that the E/D ratio can be less than one, meaning that etching can also yield net deposition: "[t]he magnitude of E/D on the side walls is < 1 ... The sidewalls receive a net deposition." (A1174 col. 13 ll. 13-19; A2653 ¶ 99.) Thus, in the

'977 patent, etching is not limited to net etching, and Rozbicki has no basis for equating those terms.

By limiting etching to net etching, Rozbicki's proposed construction renders the terms net etching and net deposition in the '977 patent nonsensical. With Rozbicki's construction, etching means net etching or the net removal of material. This means that net etching is net net etching or the net net removal of material, which makes no sense. Similarly, with Rozbicki's construction, net deposition is the net net growth of material, also illogical. Even Rozbicki's expert, Dr. Ruzic, was unable to articulate any logical meaning for the term "net etching" when etching is given the meaning proposed by Rozbicki's construction. (A6; A2019 at 33:23-34:11.) He was forced to conclude "net etching is not the best use of English," a conclusion that results solely from adopting Rozbicki's proposed construction. (A6; A2019 at 33:23-34:11.)

2. E/D Ratios of Greater than One Cannot Be Read From the '977 Specification into the Term Etching

Rozbicki argues that the '977 specification teaches three scenarios with "an E/D greater than 1 at the via bottom," and that the term etching should be limited to that ratio. (Br. at 26.) This argument is misguided—most of the Chiang claims do not recite an E/D ratio of greater than 1; they recite etching. To limit etching to an E/D ratio greater than 1 changes the meaning of etching, violating a fundamental claim construction principle. *Phillips v. AWH Corp.*, 415 F.3d 1303,

1323 (Fed. Cir. 2005) (en banc) (“[A]lthough the specification often describes very specific embodiments of the invention, we have repeatedly warned against confining the claims to those embodiments.”); *Nazomi Communications, Inc. v. ARM Holdings, PLC*, 403 F.3d 1364, 1369 (Fed. Cir. 2005) (Claims may embrace “different subject matter than is illustrated in the specific embodiments in the specification.”).

When Chiang and Rozbicki wanted to recite an E/D ratio greater than 1 at the bottom of the via, they did so expressly in dependent claims. (A181 ll. 3-5; A1175 col. 15 ll. 44-48.) Reading an E/D ratio of greater than 1 into all the Chiang claims would render the recited E/D ratios superfluous.

For example, Chiang claim 31 and Rozbicki claim 1 recite etching at the bottom of the via in step (b). (A179 l. 5; A1174 col. 14 ll. 30-31.) Chiang claim 47 and Rozbicki claims 27 depend on Chiang claim 31 and Rozbicki claim 1, respectively, and recite applying power to the substrate in step (b) “such that the etch to deposition ratio is greater than 1 in the bottom of the plurality of vias...” (A181 ll. 3-5; A1175 col. 15 ll. 44-48.) This recited E/D ratio would be superfluous if etching were limited to an E/D ratio greater than 1. With the Board’s construction, the recited E/D limitation has meaning. Etching means the removal of material (A2653 ¶ 98), and the recited ratio in Chiang claim 47 and Rozbicki claim 27 limits that removal to a net removal of material.

Rozbicki's proposed construction improperly renders the claimed E/D ratios superfluous.³ *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 950 (Fed. Cir. 2006) ("[C]laims are interpreted with an eye toward giving effect to all terms in the claim.") (citing, *Elekta Instrument S.A. v. O.U.R. Scientific Int'l, Inc.*, 214 F.3d 1302, 1305, 1307 (Fed. Cir. 2000) (claim language "only within a zone extending between latitudes 30°–45°" does not read on a device with radiation sources extending between 14° and 43° because "[a]ny other conclusion renders the reference to 30° superfluous")).

3. The '977 Patent Teaches That E/D Ratios Can Be Less than One

The '977 patent teaches, and dependent Chiang and Rozbicki claims recite, that E/D ratios can be less than one. (A181 ll. 3-5; A184 ll. 20-22, A1171 col. 8 ll. 60-63; A1172 col. 9 ll. 5-6, 1174 col. 13 ll. 11-19, A1175 col. 15 ll. 44-48 A1176 col. 18 ll. 3-5; A2653 ¶ 99.) Chiang claim 47 and Rozbicki claim 27, specifically recite an E/D ratio of less than 1 on the field regions of the wafer. (A181 ll. 3-5; A1175 col. 15 ll. 44-48.) Rozbicki's construction conflicts with these teachings. If etching requires net etching, i.e., an E/D ratio of greater than one, then the E/D ratio cannot be less than one.

³ Chiang claim 47 and Rozbicki claim 27 recite other limitations that would cause their scope to differ from their base claims even with Rozbicki's proposed construction. (A181 ll. 3-5; A1175 col. 15 ll. 44-48.)

4. Rozbicki's Proposed Construction is Circular

Rozbicki's proposed construction is circular. It equates etching (E) to an E/D ratio greater than 1, i.e., $E=E/D >1$. With that construction, one needs to know what etching is in order to determine whether etching exists. In contrast, the Board's construction properly defines etching: the removal of material. With that construction, one does not need to know what etching is in order to determine whether it exists. This court has rejected circular claim constructions such as Rozbicki's. *See ACTV, Inc. v. The Walt Disney Co.*, 346 F.3d 1082, 1090 (Fed. Cir. 2003) (rejecting a construction of "URL" using "Internet address," when the latter is construed using the term "URL."); *Harris Corp. v. IXYS Corp.*, 114 F.3d 1149, 1152 (Fed. Cir. 1997) ("A further, compelling reason for rejecting Harris's proposed construction ... is that Harris's construction would make the limitation entirely circular.").

5. Expert Testimony Supports the Board's Construction

Dr. Cuomo's testimony supports the Board's construction. Dr. Cuomo testified that the '977 patent teaches that etching is the removal of material. (A2641 ¶ 67, A2653 ¶ 98.) He testified that to construe etching as Rozbicki proposes would render the terms "net etching" and "net deposition" confusing and the '977 patent's E/D ratio nonsensical. (A2653 ¶ 100.) The Board found Dr. Cuomo's testimony to be more credible on the issue of claim construction than Dr.

Ruzic's, which Rozbicki cited to support its construction. (A15.) This Court gives deference to the Board's findings concerning the credibility of expert witnesses. *Yorkey*, 601 F.3d at 1284; *Velander v. Garner*, 348 F.3d 1359, 1371 (Fed. Cir. 2003).

Even Dr. Ruzic's testimony, however, indicates that the term "etch" in the phrase "etch-to-deposition ratio" in the '977 patent means the removal of material, and not the net removal of material. In his 5/3/2 analysis discussed in the Statement of Facts, Dr. Ruzic claimed that the second step of Example 3 deposits barrier material at a rate of 5 Å/s, removes barrier material at the rate of 3 Å/s, yielding a net deposition rate of 2 Å/s. (A1660-A1661 ¶ 18; A2652-A2653 ¶ 97.) Dr. Ruzic admits that the E/D ratio at the bottom of the via in this analysis is 3/5, and the E (etching) in that E/D ratio is 3 Å/s. (A1660-61 ¶ 18; A2652-53 ¶ 97.) His calculated rate of removal is 3 Å/s, meaning that even he equates etching with the removal of material in the context of the E/D ratio disclosed in the '977 patent. (A1660-61 ¶ 18; A2652-53 ¶ 97.)

Dr. Ruzic's analysis also clearly demonstrates that the problems with the terms net etching and net deposition in the '977 patent stem from Rozbicki's proposed construction, not from the patent's use of those terms. When not trying to justify Rozbicki's construction, Dr. Ruzic recognized that net deposition was a fine English term and understood exactly what it meant: deposition minus etching,

5-3, which as Dr. Ruzic notes, equals 2 in his analysis. (A1660-61 ¶ 18; A2652-53 ¶ 97.)

6. Abbott Does Not Hold That Limitations from the Specification Should Be Read Into the Claims

Rozbicki's reliance on this Court's holding in *In re Abbott Diabetes Care, Inc.*, 696 F.3d 1142 (Fed. Cir. 2012), to support its proposed construction is misplaced. *Abbott* teaches that claims must be construed so as to be consistent with the specification and the claims themselves, a teaching Rozbicki's proposed construction ignores. The dispute in *Abbott* was whether the claim term "electrochemical sensor" encompasses sensors with connecting cables and wires. *Id.* at 1148. The claims recited that the electrochemical sensor includes "contact pads" and "conductive contacts." *Id.* at 1149. Those terms were found to suggest that the claimed electrochemical sensors do not have connecting cables and wires. *Id.* In addition, the Abbott specification implicitly defined the term electrochemical sensor as excluding sensors with connecting wires and cables. *Id.* at 1149-50. It repeatedly, consistently, and exclusively depicted electrochemical sensors as lacking connecting wires and cables, while simultaneously disparaging sensors with connecting wires and cables. *Id.* at 1150. Thus, following the suggestions from the terms "contact pads" and "conductive sensors" and the implicit definition in the specification, *Abbott* construed the term "electrochemical sensor" as excluding connecting cables and wires. *Id.* at 1150.

Here, in contrast, claim terms suggest the Board's construction, not Rozbicki's. The recitations of E/D ratios of greater than 1 in Chiang claim 47 and Rozbicki claim 27 have meaning with the Board's construction, but are superfluous with Rozbicki's. *See* § VII(a)(2) above. In addition, the '977 patent expressly teaches that etching can occur with net deposition, which cannot happen with Rozbicki's construction. (A181 ll. 3-5; A184 ll. 20-22, A1171 col. 8 ll. 60-63; A1172 col. 9 ll. 5-6, 1174 col. 13 ll. 11-19, A1175 col. 15 ll. 44-48 A1176 col. 18 ll. 3-5; A2653 ¶ 99.) *Abbott* mandates that the Board's construction be affirmed.

Rozbicki's argues that the use of the term deposition in the Chiang claims suggests Rozbicki's construction because the Board's construction "renders the differentiation between 'etching' and 'deposition' meaningless." (Br. at 30.) Rozbicki is wrong. As construed by the Board, etching means the removal of material, meaning deposition is growth. (A2653 ¶ 98.) Etching and deposition are distinct.

Rozbicki's argument that the '977 patent implicitly limits the term etching to the type of etching that would make barrier layers thinner is equivocal and also to no avail. (Br. at 31.) If by making the barrier layers thinner, Rozbicki means net thinning, Rozbicki is wrong. The '977 patent expressly teaches that etching can occur with net deposition. (A181 ll. 3-5; A184 ll. 20-22, A1171 col. 8 ll. 60-63;

A1172 col. 9 ll. 5-6, 1174 col. 13 ll. 11-19, A1175 col. 15 ll. 44-48 A1176 col. 18 ll. 3-5; A2653 ¶ 99.) If Rozbicki means that etching should have a thinning effect, etching has that meaning with the Board's construction. As discussed above and in the Statement of Facts, Dr. Ruzic's 5/3/2 analysis shows that etching with net deposition can make a layer half as thick as it would be without such etching. (A1660-61 ¶ 18; A2652-53 ¶ 97.)

Rozbicki argument that Figures 3C-3D implicitly define etching as net etching is also misguided. (Br. at 26; A1166.) Rozbicki argues that those figures illustrate net etching. The Board's construction of etching encompasses etching that yields net etching, so that construction is also consistent with those figures. Finally, Rozbicki's argument that text in Figure 3A that describes etching part way through a layer mandates Rozbicki's construction is similarly unavailing. The Board's construction encompasses etching that could etch part way through a layer. In addition, etching part way through a layer is an express limitation of Chiang claim 66 and the claims that depend from it. (A183 l. 10.) Reading that limitation into other Chiang claims is improper.

7. Rozbicki's Hypotheticals Do Not Support Its Construction

In the interference, Rozbicki argued that the Board's construction should be rejected because it would encompass the hypothetical removal of just one atom when 10^6 atoms were deposited. (A629 ll. 8-13.) As Rozbicki notes, the Board

found that its construction would not encompass the hypothetical one-atom change. (Br. at 30; A14.) Rozbicki does not challenge this finding. Instead, Rozbicki argues that the Board should have gone further and provided guidance as to whether the boundary for etching would encompass: a hypothetical two-atom change, a hundred-atom change, or a 10,000 atom change when 10^6 atoms are being deposited. (Br. at 30.)

The Board had ample grounds for refusing to address these additional hypotheticals. First, Rozbicki waited until it moved for rehearing of the Board's decision to raise them. (A1055, 1062-63.) A motion for rehearing is not a vehicle for raising new issues. *See Adair v. Carter*, 668 F.3d 1334, 1340 (Fed. Cir. 2012) ("Because [appellants] failed to previously address [an issue] prior to [their] petition for rehearing, the Board properly refused to consider it on rehearing.") (citing 37 C.F.R. § 41.125(c)(3)(ii) (requiring that a party identify the "place where the matter [it addresses on rehearing] was previously addressed.")). Second, as the Board held, these hypotheticals are irrelevant. (A37.) The removal at issue in this interference is not of a handful of atoms with the deposition of 10^6 atoms. The lower bound for that removal under Dr. Ruzic's flawed analysis is that at least half of the atoms deposited are removed. (A1660-61 ¶¶ 16-18; A2652 ¶ 96.) As this Court has held, courts (and the Board) are not required to address irrelevant hypotheticals: "claim construction is not philosophy; we need not wring our hands

Corp. v. Salomon S.A., 191 F.3d 1356, 1365 (Fed. Cir. 1999).

Third, Rozbicki provides no guidance on whether its construction would encompass the hypothetical net removal of just two, a hundred or 10,000 atoms with the deposition of 10^6 . Therefore, even if Rozbicki's additional hypotheticals had been properly raised and were relevant, they would still not support reversing the Board's construction.

B. Support for the Chiang Claims Is Uncontested with the Board’s Construction for Etching

When the Board’s construction for etching is applied, support for the Chiang claims is undisputed. In its brief, Rozbicki does not argue a lack for support for the Chiang claims as construed by the Board. Dr. Ruzic’s 5/3/2 analysis, operating as a floor for etching, establishes support for the Chiang claims as construed by the Board. (A1660-61 ¶ 18; A2652-53 ¶ 97.) Dr. Cuomo also set forth substantial evidence of support for etching as construed by the Board. (A2635-A2640, A2645-A2654.)

C. The Board Correctly Found That, Even with Rozbicki's Proposed Construction for Etching, the '671 Application Describes the Chiang Claims

The Board correctly found that the '671 application supports the etching limitation recited by the Chiang claims, with both the Board's construction and Rozbicki's. (A15.) Rozbicki seeks to overturn this finding with respect to

Rozbicki's proposed construction, arguing that the finding lacks the support of substantial evidence. But in arguing a lack of support, Rozbicki ignores most of Chiang's evidence, including most of the testimony of Dr. Cuomo and his sputtering yield analysis. The testimony and analysis of Dr. Cuomo, a Distinguished Research Professor at North Carolina State University and a Recipient of the National Medal of Technology, however, cannot be disregarded. (A4; A2623.) This is particularly true given that the Board found his testimony to be more credible than Dr. Ruzic's, upon which Rozbicki relies. (A15.) This Court gives great deference to the Board's determinations of credibility. *Yorkey*, 601 F.3d at 1284 ("[T]he Board was well within its discretion to give more credibility to Baura's testimony over Causevic's unless no reasonable trier of fact could have done so."); *Velander*, 348 F.3d at 1371 ("It is within the discretion of the trier of fact to give each item of evidence such weight as it feels appropriate."). Rozbicki fails to acknowledge that it had the ultimate burden of proof on written description and that the pertinent issue is what a specification describes to one skilled in the art, not whether claims have *ipsis verbis* support.

When fully examined, the record provides substantial evidence that: the resputtering described in the '671 application net etches the bottom of the via; Example 3 combines the teachings of Examples 1 and 2, producing an embodiment of the Chiang claims with net etching at the bottom of the via; and Dr. Cuomo's

sputtering yield analysis establishes that Example 3 is an embodiment of the Chiang claims. The Board's judgment should be affirmed.

1. Rozbicki Had the Burden of Proving Its Written Description Challenge

Rozbicki argues that Rozbicki met a threshold showing to proceed with its motions "shifting the burden to Chiang to establish an inherent disclosure." (A40.) The Board properly rejected that argument. As the Board held, under its rules: "[t]he party filing the motion has the burden of proof to establish that it is entitled to the requested relief." (A2 citing 37 C.F.R. § 41.121(b); A93.) Regardless of whether the burden of going forward might have shifted at some point, the ultimate burden of proof always remained with Rozbicki. (A40; A93.) *See also Bilstad v. Wakalopoulos*, 386 F.3d 1116, 1120-21 (Fed. Cir. 2004); *Kubota v. Shibuya*, 999 F.2d 517, 520-22 (Fed. Cir. 1993). This means Chiang did not have to prove anything. Dr. Ruzic's lack of credibility alone could defeat Rozbicki's motions.

Chiang also did not have to prove, address or rely on inherency for support. While Chiang did not provide *ipsis verbis* support for the words "etching" or "net etching," Chiang provided descriptions, figures and examples that convey etching and net etching to one skilled in the art. Rozbicki cannot disregard those express disclosures of etching and net etching and cannot shift the ultimate burden of proof to Chiang.

2. Substantial Evidence Supports the Board's Finding That the Resputtering in the '671 Application Conveys Net Etching to One Skilled in the Art

Rozbicki acknowledges that the Board found that the resputtering disclosed in the '671 application describes the etching recited in the Chiang claims even with Rozbicki's proposed construction. (Br. at 33.) Substantial evidence supports this finding.

First, even Rozbicki concedes that resputtering is the mechanism by which etching can occur. Rozbicki attributes its own invention to the discovery of resputtering to etch barrier material: "Rozbicki found it was possible to etch the via bottom by resputtering barrier material from the via bottom while depositing barrier material elsewhere on the substrate" (A1649 ¶ 34.)

Second, as Dr. Cuomo testified and the Board found, the resputtering described in the '671 application conveys net etching to one skilled in the art. (A7, A15; A39-40; A2639 ¶ 60, A2640 ¶ 62.) The resputtering and sputtering in the '671 application breaks through into the substrate unless barrier material is previously deposited to protect the underlying substrate. (A1190 ll. 10-14; A2640 ¶ 62.) Such breakthrough conveys net etching to one skilled in the art. (A2632 ¶ 45, A2640 ¶ 62.). Resputtering that sculpts and reshapes barrier material also conveys net etching to one skilled in the art. (A2639 ¶ 60.)

Third, the resputtering described in the '671 application is created by applying a “sufficiently high substrate bias.” (A1188 ll. 11-13; A2635 ¶ 53.) This “sufficiently high substrate bias” causes breakthrough into the substrate (when the substrate is not protected) and sculptures and reshapes barrier material, meaning it is “sufficiently high” for net etching. (A1198 ll. 18-20, A1190 ll. 10-14; A1201 ll. 3-5; A2633 ¶48, A2639 ¶ 60, A2640 ¶ 62.) Even the '977 patent concedes that such a substrate bias would create etching (net etching with Rozbicki’s construction): “[i]n general, etch rate is most strongly related to the RF power [used to bias a wafer substrate].” (A1173 col. 12 65-66; A2633 ¶ 47.)

3. Substantial Evidence Supports the Board’s Finding That Example 3 Is an Embodiment of the Chiang Claims

Substantial evidence supports the Board’s finding that Example 3 is an embodiment of the Chiang claims. As the Board found, Example 3 combines the methods taught by Examples 1 and 2, performing net etching in its second step. (A11.) Example 3 indisputably uses the method of Example 2 as its first step. (A1660 ¶ 17.) Substantial evidence, including the testimony of Dr. Cuomo, establishes that Example 3 uses the method of Example 1 in its second step, which results in net etching. (A2635-36 ¶ 53, A2639 ¶ 60.)

a. The First Step of Example 3 Uses the Method of Example 2

It is undisputed that the first step of Example 3 uses the method of Example 2. Dr. Cuomo so testified, and Dr. Ruzic agreed: “The first deposition period in Example 3 of the ’671 Application appears to have been conducted under conditions that, for practical purposes, are identical to those of Example 2.” (A1660 ¶ 17; A2635-36 ¶ 53, A2639 ¶ 60.)

b. The Second Step of Example 3 Uses the Method of Example 1 and Performs Net Etching

Substantial evidence supports the Board’s finding that the second step of Example 3 uses the teachings of Example 1 and net etches the bottom of the via. (A11.) As the Board found, the conditions of Example 1 and second step of Example 3 are sufficiently similar to indicate to one skilled in the art that the second step of Example 3 uses the teachings of Example 1. (A11.) As the application discloses, Example 1 and the second step of Example 3 use the same pressure, the same RF power to the coil, and the same DC power. (A10; *compare* A1198 ll. 9-14, *with* A11200 ll. 20-23.) They also use very similar substrate biases. (A10; *compare* A1198 l. 11, *with* A1200 l. 26.) As Dr. Cuomo testified, the second step of Example 3 uses the process of Example 1. (A2635 ¶ 53, A2639 ¶ 60, A2646 ¶ 79.)

While the substrate biases used in Example 1 and in the second step of Example 3 are slightly different, both are described in the '671 application as being "sufficiently high" to cause breakthrough or reshaping. A1198, A1200-A1201; A2646. In particular, in Example 1 "the high substrate bias [of -70 V] caused a break-through 328 at the bottom 316 of the via 313" (A1198 ll 11, 18-19.) The second deposition step of Example 3 uses a "sufficiently high substrate bias" of -60V to "sculpture a shape" from previously deposited barrier material and to "resputter" and to "reshape[]" that material near the bottom 516 of the via 513. (A1188 ll. 12-13, A1201 ll. 3-5; A2635 ¶ 53, A2639 ¶ 61). As Dr. Cuomo testified, substrate biases of -60 and -70V both produce net etching at the bottom of a via. (A2646 ¶ 79.)

As the Board found, Figures 3-5 also demonstrate that net etching occurs in the second step of Example 3. (A15.) As the Board stated, Example 3 achieves its described result "by offsetting the results of method steps similar to example 2 with the results of method steps similar to example 1." (A11.) As Figure 4 shows, the method of Example 2 deposits excess barrier material in the middle of the via while leaving the corners at the bottom thin. (A1199 ll. 11-16, A1210; A2634 ¶ 50.) As Figure 3 shows, Example 1 net etches the bottom of the via, particularly in the center, but deposits barrier material in the corners. (A1198 ll. 18-22, A1210; A2632 ¶ 45.) When combined, the method of Example 2 produces excess barrier

material in the middle of the via and leaves the corners thin, then the method of Example 1 net etches the excess barrier material in the middle while adding barrier material to the corners. (A1201 ll. 3-10; A2639 ¶¶ 60-61.) This produces the flat layer shown in Figure 5 demonstrating net etching in the second step of Example 3. (A1201 ll. 5-10; A2639 ¶¶ 60-61.)

This net etching is further confirmed by the '671 application's express teaching that the barrier material deposited in the first step protects the substrate during the second step: "Availability of the material which was deposited at the lower bias voltage on the surface of a trench or via protects the substrate surface under the barrier or wetting layer material during the sputtering deposition at higher bias voltage." (A1190 ll. 10-13; A2642 ¶ 62.) As the Board found, and as Dr. Cuomo testified: "the excess created by the example 2-like method [in the first step] provides a buffer against break-through when the removal in the example 1-like method is subsequently employed." (A11; A2642 ¶ 62.)

In light of all of these teachings the Board correctly held that, "[i]t is not clear how Chiang's disclosure would make any sense if etching is not occurring in the second step [of Example 3].” (A38.)

4. Dr. Cuomo's Sputtering Yield Analysis Supports the Board's Finding of Written Description Support

Dr. Cuomo's sputtering yield analysis is substantial evidence supporting the written description support found by the Board. As discussed in Section III(F)(4)

above, Dr. Cuomo determined the plasma potential, sputtering yields and ion fluxes for Example 3 using art accepted values. Those values establish as a scientific fact that Example 3 net etches the bottom of the via. That scientific fact supports the Board's judgment.

5. Rozbicki's Arguments Do Not Negate the Substantial Evidence Supporting the Board's Finding of Written Description Support

Rozbicki argues that the '671 application does not support the etching recited in the Chiang claims (with its construction) for a variety of factual reasons, each of which is refuted by substantial evidence.

a. The Second Step of the '671 Application's Two-Step Method Is Termed a Deposition Step Because It Deposits Material

Rozbicki's argument that the second step of the '671 application's two step method does not etch barrier material because it is termed a deposition step is misguided. That second step is termed a deposition step because it deposits barrier material, for example, on the sidewalls, not because it lacks etching. (A1190 ll. 5-10; A2629 at ¶ 38, A2635 ¶ 53.) The '671 application uses the term deposition to refer to the process of Example 1 even though that process indisputably net etches the bottom of a via. (A1198 ll. 9, 13-14, 21; A2631 ¶ 43, A2632 ¶ 45.) The claimed etching step requires that barrier material be deposited elsewhere while etching the bottom of the via. (A179 ll. 5-8; A2644 ¶ 74.) Therefore, the claimed

etching step is also a deposition step. Even Rozbicki's priority provisional application recognizes that the term deposition can refer to a step that etches while depositing material elsewhere. That application labels a step that etches the bottom of a via while depositing elsewhere as being the second of two "HCM Ta(N) Deposition" steps. (A1868, A1876⁴; A2640 ¶ 64.)

b. Written Description Support Does Not Require *Ipsis Verbis* Support

Rozbicki's argument that the '671 application lacks *ipsis verbis* support for etching is unavailing. Written description requires that the specification reasonably convey etching at the bottom of a via to one skilled in the art. *See LizardTech, Inc. v. Earth Resource Mapping, Inc.*, 424 F.3d 1336, 1345 (Fed. Cir. 2005). The '671 application's use of the terms "resputtering," "sculpturing," and "reshaping;" its figures; its text; and its conditions convey etching to one skilled in the art even as that term is construed by Rozbicki.

c. The '671 Application's Teachings of Avoiding Erosion and Contamination Describe Etching

Rozbicki's argument that the '671 application teaches protecting the semiconductor feature surface from erosion and contamination and therefore cannot teach etching is misguided. The '671 application teaches that to protect the semiconductor feature surface from erosion and contamination, barrier material

⁴ Rozbicki's priority application is Rozbicki Exhibit 2017. (A403.)

should first be deposited before etching occurs. (A1190 ll. 10-16; A2640 ¶ 62.)

The application teaches that this previously deposited barrier material protects surfaces from the erosion and contamination otherwise caused by etching. (A1190 ll. 10-16; A2640 ¶ 62.) This teaching demonstrates, rather than undermines, the application's support for etching, since if there were no etching, there would be no need to protect from erosion or contamination.

d. The Similarities Between Example 1 and the Second Step of Example 3 Support the Board's Finding of Etching

Rozbicki's argument that the few differences between Example 1 and the second step of Example 3 render Example 1 irrelevant is unavailing. The Board found that the similarities between Example 1 and the second step of Example 3 would convey to one skilled in the art that the second step of Example 3 is using a method like that disclosed in Example 1. (A11.) Substantial evidence, including the testimony of Dr. Cuomo, supports that finding. (A2639 ¶ 60, A2646 ¶ 79.) Rozbicki identifies nothing that would mandate that finding's reversal. While it identifies a difference in temperature between Example 1 and the second step of Example 3, Rozbicki does not even argue, let alone prove, that the temperature difference would have any impact. In fact, the same temperature difference existed between Example 2 and the first step of Example 3, and Dr. Ruzic concluded that Example 2 and the first step of Example 3 had, for all practical purposes, identical

conditions. (*Compare*, A1199 l. 10, *with* A1201 l. 3; A1660 ¶ 17.) Rozbicki also notes that the duration of the process of Example 1 was not recorded, but again does not argue, let alone prove, that that fact would affect net etching.

The only specific argument Rozbicki makes regarding the differences between Example 1 and the second step of Example 3 concerns the substrate bias. Rozbicki argues that Dr. Cuomo admitted that a 10V difference in a substrate bias could dramatically affect sputter yields at energies of 60-70eV. (Br. at 37.) The argument is both irrelevant and wrong. First, as Dr. Cuomo testified, the relevant energy range for the second step of Example 3 is 85-120eV, not 60-70eV. (A2647-48 ¶ 84.) Second, Dr. Cuomo never testified that sputtering yields were dramatically affected by a 10V difference in substrate biases at 60-70 eV. Dr. Cuomo merely acknowledged that a best-fit curve in an article by Matsunami et al. was steep at those energies. (A2373 at 226:13-24.) But, as Dr. Cuomo testified, that best-fit curve, fit for a broad range of energies, is not accurate at low energies, such as 100 eV, let alone 60-70eV. (A2887 ¶ 6.)

e. Rozbicki's Speculation About the Gas Used in Examples 1-3 Does Not Undermine the Board's Factual Finding

Rozbicki's argument that because the gas used in the '671 application is not expressly mentioned, one skilled in the art could perceive the teachings of Examples 1, 2 and 3 to be unrelated is both irrelevant and unsupported. Rozbicki

cites no evidence to support its speculation about what one skilled in the art *could* think. Dr. Cuomo testified that one skilled in the art would view the teachings of Examples 1 and 2 as highly relevant to Example 3. (A2635-A2636 ¶ 53; A2639 ¶ 60.) Even Rozbicki's expert Dr. Ruzic testified that the first step of Example 3 is equivalent to Example 2, even though the gas used in those two examples is not expressly mentioned. (A1660 ¶ 17.) All three examples used the same equipment and had a common preceding description of their setup. (A1197 ll. 2-6, 1198 ll. 5-9, A1199 ll. 2-6, A1200 ll. 16-20.) Substantial evidence therefore supports rejecting Rozbicki's conjecture.

f. Rozbicki's Argument That Combining Examples 1 and 2 Would Narrow the Top of the Via Is Unpersuasive

Rozbicki's argument that Example 3 cannot be a combination of the steps of Examples 1 and 2 because that combination would narrow the top of the via is unavailing. Substantial evidence refutes that argument. Rozbicki relies on a slight variation in shape along the sidewalls of the via in Figure 3 to support its argument, but Rozbicki inconsistently maintains that the figures cannot be relied on to show far more dramatic differences in shape. (A2286 ¶¶ 4-5.) When one examines the text of the examples, only Example 2 is reported as having a problem with "overhang at the top of a contact via which can lead to closure of the via opening." (A1276 ¶ 6-10; A2635 ¶ 52.) Example 1 has no such problems. In

Example 1, “the layer thickness control over the upper portion of the via wall was good.” (A1198 ll. 17-18.) Therefore, Rozbicki has not proven that the combination of Examples 1 and 2 would have resulted in the problem of Example 2, particularly since Example 3 uses the method of Example 1 for a longer period of time (45 seconds) than it uses the method of Example 2 (15 seconds).
(Compare A1200 l. 24, with A1201 l. 1.)

g. Rozbicki’s Argument That Etching Occurs Only at the Top of the Via in Example 3 Is Scientifically Unsound

Rozbicki’s argument that the second step of Example 3 removes material only at the top of the via, where it “must fall and be deposited at the via bottom” is unavailing. The Board had ample basis to reject that argument. Dr. Cuomo testified that etching would not be limited to the top of the via as Rozbicki contends. (A2641 ¶¶ 65-67.) The ’977 patent itself acknowledges that etching effects are generally greater at the bottom of wafer surfaces, not the top. (A1169 col. 4 ll. 5-8; A2641 ¶ 65.) The ’671 application teaches that the barrier material at the bottom protects the substrate from breakthrough – that barrier material would not be protecting the substrate from breakthrough if net etching were not occurring at the bottom of the via. (A1190 ll 10-13; A2640 ¶ 62.)

h. Dr. Ruzic's Technical Analysis Was Not Credible

Rozbicki's argument that the Board should have discussed and presumably credited Dr. Ruzic's technical analysis is untenable. The Board found the testimony of Dr. Ruzic to be not as credible as Dr. Cuomo's. The Board had ample basis to reach that conclusion.

Dr. Ruzic performed a sputtering yield analysis, but he did not use art-recognized sputtering yields. Instead, he generated sputtering yields using a type of software that the art recognizes is not accurate at the energy range used for his calculations: ions with 200 eV or less energy. (A2648 ¶ 85.) Specifically, Dr. Ruzic used TriDyn, an approximation simulation using modified TRIM code. (A1663 ¶ 22.) TRIM has known issues of reliability in the energy range of Dr. Ruzic's calculations. (A2648 ¶ 85.) An article by Torre et al. addresses sputtering yields for argon on tantalum at 100 eV and states that TRIM parameters are fit to high energy collisions and that TRIM may be inaccurate in the range of 500 eV and below. (A2648 ¶ 85; A2773.)

The credibility of Dr. Ruzic's analysis is also undermined by the fact that he did not disclose a critical parameter used to generate his sputtering yields—the surface binding energy—a parameter that he could control. The TriDyn user manual states that surface binding energies critically affect the sputtering yields and that: “Theoretically, the sputtering yield is proportional to the inverse of the

surface binding energy.” (A3013, A3022-A3026 at 3022.) Other than speculating that he may have used an unknown default estimate, Dr. Ruzic never discloses or justifies his estimate for surface binding energy. (A3219-20 at 136:10-137: 17.) Under the Board’s Standing Order, expert opinions that do not disclose critical underlying facts or data “may be given little, or no, weight.” (A61, A118.)

Dr. Ruzic’s interference-generated sputtering yields are also not credible because they conflict with published sputtering yields in a manner that always favored Rozbicki: his generated yields were always lower than the art-recognized values, thereby underestimating etching. A comparison between values Dr. Ruzic generated and experimental values reported by Stuart, Laegreid, and Hechtl is shown below:

Energy	Dr. Ruzic	Stuart	Laegreid	Hechtl
100 eV	0.041 (A1708)	0.1 (A2786) (Fig. 11)	0.1 (A2777) (Table 1)	--
150 eV	0.091 (A1708)	0.2 (A2786) (Fig. 11)	0.2 (A2777) (Table 1)	0.2 (A3010)

Dr. Ruzic tried to justify the conflict between his interference-generated data and the published values in Laegrid and Stuart, by arguing that the data in Stuart and Laegrid are recognized as outdated and unreliable. Dr. Cuomo and recent peer reviewed literature, including an article co-authored by Dr. Ruzic refute that

assertion. A 2001 article co-authored by Dr. Ruzic reports sputtering yields from Laegrid without any disclaimer of alleged unreliability. (A3306, A3308.) Other recent articles, including a 2012 article by Yan et al. and a 2010 article by Hundur et al., report sputtering yield data from Stuart and Laegrid without any disclaimers of the data being outdated or unreliable. (A2892, A2903; A2913-A2914; A2885-A2886 ¶ 4.) In fact, Stuart is cited by 103 articles, and Laegrid is cited by 270 articles. A2730-A2740; A2741-A2746; A2885

The fact that Dr. Ruzic could not demonstrate a lack of net etching with the art-recognized sputtering yields and instead had to use an unreliable method to generate more favorable sputtering yields is itself substantial evidence supporting the Board's finding of written description support.

D. Rozbicki Did Not Properly Raise or Prove a Breadth-Written Description Challenge to the Chiang Claims

1. Rozbicki Did Not Properly Raise a Breadth-Written Description Challenge to the Chiang Claims

The Board found that Rozbicki did not properly raise an issue of breadth-written description support, and this Court provides great deference to the Board's determination of compliance with its procedural requirements. (A40.) *See Eli Lilly & Co. v. Bd. of Regents of the Univ. of Wash.*, 334 F.3d 1264, 1266 (Fed. Cir. 2003).

Rozbicki's argument that it properly raised the breadth issue with reply briefing is unavailing. (Br. 42-45.) The Board correctly held that its procedures do not permit parties to raise new issues on reply. (A40.) The Board's Standing Order states: "A reply that raises a new issue will not be considered and may be returned." (A99.)

Rozbicki's argument that Chiang's opposition made the issue ripe on reply is unavailing. Rozbicki cannot claim to be surprised that Chiang in its opposition cited to Example 3 and the '671 application's disclosure of resputtering as supporting the etching recited by the Chiang claims. Chiang cited that support in its 2005 Request for an Interference, an exhibit to Rozbicki's motions. (A427; A1531-A1536.)

Further, as the Board held, by waiting until after Chiang filed its opposition to purportedly raise a breadth written description challenge, Rozbicki denied Chiang the opportunity to substantively respond. (A40.) Ruling on such a challenge without giving Chiang an opportunity to respond would violate due process. *See Rambus Inc. v. Rea*, 731 F.3d 1248, 1255-56 (Fed. Cir. 2013) (When considering a rejection of a party's claims to which that party did not previously have an opportunity to respond, the Board must provide an "appropriate opportunity to respond and, if necessary, supplement the record.") Otherwise, the Board would deprive that party of its "due process rights.")

2. Even if Rozbicki's Breadth Challenge Were Considered, Substantial Evidence Supports the Board's Finding of Written Description Support

Even if Rozbicki's belated breadth challenge were considered, it would still fail. Rozbicki merely argues that the term sputtering and resputtering in isolation do not have exactly the same scope as the term etching in isolation. Claim terms however, cannot be viewed in isolation. *Phillips*, 415 F.3d at 1313 ("We cannot look at the ordinary meaning of the term ... in a vacuum."') (quoting *Medrad, Inc. v. MRI Devices Corp.*, 401 F.3d 1313, 1319 (Fed.Cir.2005)). They must be construed in light of the claims in which they appear. *Phillips*, 415 F.3d at 1313 ("Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification."').

Here, the Chiang claims do not merely recite etching at the bottom of the via, they recite etching at the bottom of the via while depositing barrier material elsewhere. The scope of the etching encompassed by the claims therefore is limited to etching that can occur while barrier material is deposited elsewhere. Methods that cannot etch while barrier material is being deposited elsewhere are irrelevant.

Rozbicki has not argued, let alone proven, that any etching method, other than resputtering, can etch barrier material at the bottom of a via while barrier

material is being deposited elsewhere. Rozbicki merely argues that the term etching in isolation could encompass chemical and reactive ion techniques. Dr. Cuomo testified that techniques like chemical etching are irrelevant because they cannot etch while barrier material is being deposited. (A2639 ¶ 60.) Thus, even if Rozbicki's belated breadth challenge is considered, substantial evidence, including Rozbicki's lack of proof, supports its rejection.

E. Rozbicki's Challenge to Chiang's Priority Applications Fails

Rozbicki argues that the Board erred in granting Chiang the benefit of its priority applications for the same reasons the Board purportedly erred in finding support for the Chiang claims. As Rozbicki admits the disclosures in the Chiang priority applications are in all essential details identical to the disclosure in the '671 application. (Br. at 45.) In fact, the Chiang priority applications and the '671 application are continuations of one another. (A298, 299, 1177.)

As discussed above, the Board's finding that the '671 application describes the Chiang claims is supported by substantial evidence. That same substantial evidence supports the Board's finding that Chiang is entitled to the benefit of its priority applications.

VII. CONCLUSION

For the foregoing reasons, this Court should affirm: (i) the Board's claim construction, (ii) the Board's finding of fact that, with both its construction and

Rozbicki's proposed construction, the '671 application describes the Chiang claims on appeal, and (iii) the Board's finding that the Chiang priority applications describe the Count. The Board's judgment should be affirmed.

Respectfully Submitted,

Date: February 12, 2014

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CERTIFICATE OF FILING AND SERVICE

I hereby certify that on this 12th day of February, 2014, the foregoing BRIEF OF APPELLEES is being filed with the Clerk of the Court using the CM/ECF System, and a copy is being served via electronic mail to counsel for Appellants as follows:

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I hereby certify that two copies of the BRIEF OF APPELLEES will be mailed to counsel for Appellants on the date that paper copies are sent to the Court.

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